

M 574/987

Preprint from the 1987

BUREAU OF MINES MINERALS YEARBOOK

The Mineral Industry of Mexico



UNITED STATES DEPARTMENT OF THE INTERIOR

I 28.37/a 2!



best copy available



UNITED STATES DEPARTMENT OF THE INTERIOR • Manuel J. Lujan, Jr., Secretary

BUREAU OF MINES • T S Ary, Director

This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals and Minerals; Volume II, Area Reports: Domestic; Volume III, Area Reports: International*. The separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

The Mineral Industry of Mexico

By Jerome F. Machamer¹

Mexico's mineral industry staged a significant recovery in 1987, despite inflation of about 60%, concern over the repayment of foreign debt, and the rising cost of spare parts and other imported supplies. The improvement was due to increased production of several major mineral commodities and to generally improved world price levels compared with those of 1986. Sales volume for Petroleos Mexicanos (PEMEX) increased by approximately \$2 billion or 19% more than that of 1986, while the value of silver produced rose by about \$140 million or 35% compared with that of 1986. The gross domestic product increased by 1.4% in real terms during the year, while overall growth in the mining sector was 3.8%.

Mexico was the world's fifth largest producer of petroleum, after the Soviet Union, the United States, Saudi Arabia, and China; petroleum production increased slightly in 1987. Petroleum reserves, however, declined slightly, reflecting the decrease in exploration activity, which was a result of the reduced oil prices of earlier years. Mexico continued to be the world's largest producer and exporter of silver, which was the coun-

try's second most important mineral product. Mexico was also the world's leading producer of fluorspar and was a major producer of antimony, arsenic, barite, bismuth, celestite, graphite, lead, mercury, molybdenum, sodium sulfate, sulfur, and zinc.

Important governmental actions taken during the year include the Economic Solidarity Pact, an agreement between Government, business, labor unions, and rural workers, under which the minimum wage would be tied to increases in the price of a group of basic commodities. At the same time, prices of several Government-produced or provided goods and services, including petroleum products and electricity, were sharply increased. The objectives were to stabilize the general economy and to reduce inflation. Royalties (*derechos de minería*) were reduced for small and medium miners. An important development for the future was the announcement late in the year of plans to sell or otherwise dispose of Government interest in about 50 state-owned companies, including several medium and large mining companies.

PRODUCTION

Within the mineral fuels category, production of crude oil, natural gas, and run-of-mine coal all increased. Production of steam coal increased, while production of washed metallurgical coal and coke apparently decreased. Production of refinery products increased. Mexico was essentially self-sufficient in regard to energy minerals and derived products.

In the metallic minerals sector, there were significant increases in the production of copper ores and smelter and refinery

products, reflecting the basic changes in the country's copper economy that were occurring with the startup of the new smelter of Mexicana de Cobre S.A. Aluminum, cadmium, and zinc output rose, while production of mined and refined lead declined. Silver production rose to a recent new high; gold production increased, although not to the record-high level achieved in 1984. Production of crude and finished steel and of ferroalloys reached new highs, while production of manganese ore declined.

In the industrial minerals area, production of barite, cement, gypsum, magnesia, salt, sodium sulfate, strontium minerals, and sulfur all rose, while production of clays, fluorspar, and phosphate rock declined.

Employment in the mineral industries rose 2% to 225,000. With a reported dependency factor of 5.5, approximately 1.24 million people (1.5%) depend upon the mineral industry for employment.

Table 1.—Mexico: Production of mineral commodities¹

(Metric tons unless otherwise specified)

Commodity ²	1983	1984	1985	1986	1987 ³
METALS					
Aluminum:					
Primary	39,706	43,988	42,744	39,946	43,260
Secondary	15,122	19,636	22,078	18,925	8,765
Antimony					
Mine output, Sb content ⁴	2,519	3,064	4,266	3,337	2,839
Metal (in mixed bars and refined)	1,782	1,907	2,694	1,955	1,692
Arsenic ⁴					
White	3,395	4,067	3,918	4,030	4,545
Impure	57	97	864	1,235	759
Bismuth ⁵	545	433	925	749	1,012
Cadmium:					
Mine output, Cd content	1,341	1,135	1,140	1,183	1,243
Metal, refined	847	838	905	1,016	935
Copper ⁶					
Mine output, Cu content	198,928	185,210	172,897	184,618	247,592
Metal:					
Blister (primary only)	79,543	70,339	76,182	74,662	127,574
Refined:					
Primary	83,490	92,163	123,565	89,494	130,039
Secondary ⁷	15,000	13,900	14,000	7,060	NA
Total ⁸	98,490	106,063	137,565	96,554	130,039
Gold:					
Mine output, Au content — troy ounces	198,179	271,001	265,696	230,972	234,522
Metal, refined — do.	177,504	177,118	198,723	189,207	205,507
Iron and steel:					
Iron ore, mine output:					
Gross weight ¹ — thousand tons	8,040	8,317	7,820	7,298	7,523
Fe content — do.	5,306	5,489	5,161	4,817	4,965
Metal:					
Pig iron — do.	3,537	3,926	3,595	3,724	3,698
Sponge iron — do.	1,497	1,448	1,500	1,325	1,540
Total — do.	5,034	5,374	5,095	5,049	5,238
Ferroalloys:					
Ferromanganese — do.	140	160	154	156	161
Silicomanganese — do.	42	42	39	61	40
Ferro silicon — do.	24	23	28	18	18
Ferrochromium — do.	3	7	6	3	6
Other — do.	1	2	3	1	1
Total — do.	210	234	230	239	266
Steel, crude — do.	6,978	7,560	7,367	7,170	7,571
Rolled products — do.	5,473	6,025	6,042	5,623	5,791
Forgings and castings — do.	68	59	56	26	40
Lead:					
Mine output, Pb content	184,261	202,561	197,489	195,449	177,161
Metal:					
Smelter:					
Primary	166,550	174,697	203,036	181,989	176,986
Secondary (refined) ⁹	31,000	30,000	31,000	33,000	35,000
Total ⁸	197,550	204,697	234,036	214,989	211,986
Refined:					
Primary (including lead content of antimonial lead)	162,461	163,205	193,525	178,860	173,830
Secondary ⁹	31,000	30,000	31,000	33,000	35,000
Total	193,461	193,205	224,525	211,860	208,830

See footnotes at end of table.

Table 1.—Mexico: Production of mineral commodities¹—Continued

(Metric tons unless otherwise specified)

Commodity ²	1983	1984	1985	1986	1987 ³
METALS—Continued					
Manganese ore					
Mn content	123,094	180,940	150,647	174,416	146,407
Gross weight, metallurgical ore ⁴	² 286,600	² 431,300	² 337,400	394,300	336,000
Gross weight, battery grade ore ⁵	16,000	19,000	22,200	38,700	41,300
Mercury, mine output, Hg content					
76-pound flasks	6,411	¹ 11,139	¹ 11,429	5,366	3,597
Molybdenum, mine output, Mo content	5,866	4,954	5,761	3,296	4,319
Selenium, mine output, Se content	24	44	42	23	29
Silver					
Mine output, Ag content					
thousand Troy ounces	63,607	75,340	73,167	77,753	⁶ 77,643
Metallurgical products, Ag content	58,545	69,022	66,061	71,670	75,651
Metal, refined, primary	53,487	53,023	61,651	62,261	68,876
Tin					
Mine output, Sn content	334	416	380	585	369
Metal, smelter, primary	1,216	1,331	1,492	1,474	1,723
Tungsten, mine output, W content	186	274	282	294	213
Zinc					
Mine output, Zn content	296,292	303,373	291,938	278,065	271,480
Metal, smelter, primary	174,991	167,034	175,353	173,700	
Metal, refined, primary	171,390	162,912	171,388	172,489	184,755
INDUSTRIAL MINERALS					
Abrasives, natural ⁸	⁷ 191	⁷ 606	⁷ 245	1,458	12,390
Barite	357,043	426,095	467,693	321,186	401,336
Cement, hydraulic	thousand tons	17,068	18,436	20,680	19,751
Clays					
Bentonite	226,140	267,348	267,695	136,478	129,596
Common clay	213,775	212,758	254,606	248,351	178,347
Fuller's earth	41,574	45,697	58,090	52,200	49,112
Kaolin	162,000	130,296	282,337	276,427	151,104
Diatomite ¹⁰	43,367	44,634	45,781	36,022	34,708
Feldspar ¹⁰	117,518	⁷ 295,036	⁷ 332,031	85,619	106,490
Fluorspar ¹¹					
Acid grade	thousand tons				291
Ceramic grade	do.				
Metallurgical grade	do.	NA	NA	NA	244
Submetallurgical grade	do.				180
Total	do.	⁷ 527	⁷ 627	⁷ 697	724
Graphite, natural					
Amorphous	42,669	39,846	33,468	36,618	36,674
Crystalline	1,658	1,683	1,919	1,838	1,787
Gypsum and anhydrite, crude (see 12)	2,958,085	⁷ 4,260,022	⁷ 4,692,796	4,232,805	4,375,416
Lime, hydrated and quicklime ¹²	thousand tons	3,630	4,000	⁷ 5,545	4,400
Magnesium compounds					
Magnesia ¹³	66,300	105,701	121,698	99,965	118,332
Magnesite	23,187	30,424	19,299	⁷ 7,530	7,351
Mica, all grades ¹⁰	1,560	1,676	1,446	1,748	3,419
Nitrogen, N content of ammonia	1,935,500	1,772,610	1,858,778	¹² 1,652,051	¹³ 1,794,344
Perlite ¹⁰	41,377	31,515	37,261	46,170	39,428
Phosphate rock ^{10 14}	thousand tons	785,038	⁷ 652,651	⁷ 786,500	746,863
Salt, all types	3,703	6,167	6,467	6,205	6,199
Sodium compounds					
Sodium carbonate (soda ash)					
Natural	179,700	192,000	200,185	⁷ 200,000	⁷ 180,000
Synthetic	317,900	231,008	257,223	⁷ 250,000	⁷ 250,000
Sulfate, natural (blowite) ¹⁵	395,287	413,238	⁷ 394,074	455,360	488,642
Stone, sand and gravel					
Calcite, common ¹⁰	344,793	480,986	400,516	437,118	486,740
Dolomite ¹⁰	363,575	392,877	330,711	453,861	411,601
Limestone ^{10 16}	thousand tons	35,256	29,055	30,840	28,919
Marble ¹⁰	149,086	149,220	263,190	258,000	261,000
Quartz, quartzite, glass sand (silica) ¹⁰	⁷ 1,188,330	⁷ 1,462,158	⁷ 1,479,100	886,411	965,921
Sand and gravel					
Sand	thousand cubic meters	50,564	52,031	⁷ 54,350	50,064
Gravel	do.	⁷ 132,744	33,604	⁷ 35,196	32,420
Strontium minerals (celestite) ¹⁰	37,506	31,991	⁷ 32,320	24,042	47,739
Sulfur, elemental					
Frasch process	thousand tons	1,225	1,364	1,551	1,588
Byproduct					1,806
Of metallurgy ⁶	do.	100	160	160	170
Of petroleum and natural gas	do.	377	462	469	462
Total	do.	1,702	1,986	2,180	2,220
					⁷ 2,484

See footnotes at end of table

Table 1.—Mexico: Production of mineral commodities¹—Continued
(Metric tons unless otherwise specified)

Commodity ²	1983	1984	1985	1986	1987 ³
INDUSTRIAL MINERALS - Continued					
Talc ¹⁰					
Vermiculite ¹⁰	11,032	8,900	29,900	24,901	17,400
Wollastonite ¹⁰	999	905	726	220	191
MINERAL FUELS AND RELATED MATERIALS					
Carbon black (negro de humo)	881,425	277,187	284,317	239,971	¹¹ 290,000
Coal, run-of-mine:					
Metallurgical	thousand tons	7,181	7,113	7,811	8,962
Steam	do	1,873	2,237	2,180	2,173
Total	do	8,999	9,308	9,771	10,135
Metallurgical coal, washed	do	3,578	3,423	3,432	3,101
Coke ¹²					
Metallurgical	thousand tons	2,960	2,893	2,890	2,584
Imperial	do	2	35	6	0
Breeze	do	27	8	0	4
Total	do	2,989	2,936	2,896	2,588
Gas, natural ¹³					
Gross	million cubic feet	1,479,560	1,373,402	1,313,227	1,252,842
Marketable	do	¹⁴ 1,319,069	¹⁵ 1,243,963	¹⁶ 1,197,427	¹⁷ 1,173,191
Natural gas liquids ¹⁸	thousand 42-gallon barrels	8,300	41,534	28,283	38,347
Petroleum ¹⁸					
Crude	do	972,922	992,317	998,113	984,092
Refinery products:					
Gasoline:					
Aviation	do	420	430	400	419
Motor, leaded and unleaded	do	¹⁹ 128,499	²⁰ 131,216	²¹ 130,044	²² 129,296
Liquefied petroleum gas	do	56,539	58,781	60,891	60,712
Jet fuel	do	9,998	12,379	12,279	12,822
Kerosene	do	14,258	11,654	11,286	9,789
Distillate fuel oil (diesel)	do	81,745	85,338	89,720	88,425
Lubricants	do	²⁴ 2,453	²⁵ 2,373	²⁶ 2,391	²⁷ 2,380
Residual fuel oil	do	127,819	137,210	146,139	147,974
Asphalt	do	6,185	8,292	8,860	8,858
Unfinished crude oil ¹⁹	do	²⁹ 0	14,577	16,964	9,940
Unspecified	do	³⁰ 27,767	³¹ 24,414	³² 26,269	³³ 28,730
Refinery fuel and losses	do	³⁵ 11,294	³⁶ 10,391	³⁷ 14,781	³⁸ 10,961
Total	do	406,977	501,772	518,903	501,374

⁴Estimated. ⁵Preliminary. ⁶Revised. NA Not available.

⁷Table includes data available through Mar. 31, 1989.

⁸In addition to the commodities listed, pumice and additional types of crude construction materials are produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

⁹Sb content of ores for export plus Sb content of antimonial and impure bars plus refined metal.

¹⁰Asenic data as reported by the Consejo de Recursos Minerales. White Arsenic in As₂O₃. Impure arsenic is considered to be impure arsenic metal.

¹¹Refined metal plus Bi content of impure smelter products.

¹²Estimated recoverable copper contained in products from primary production units. Primary refined copper includes cathode copper from the Cia. Minera de Cananea S.A. electro-winning plant: 1983—1,236 tons; 1984—9,209 tons; 1985—8,034 tons; 1986—8,033 tons; and 1987—9,662 tons (Camara Minera de Mexico, 1988).

¹³Calculated from reported Fe content on the basis of concentrate and pellets containing 66% iron. Total run-of-mine output in 1986 was just under 15 million tons.

¹⁴Reported production of calcined manganese ore.

¹⁵Based on exports, comprised mostly of pumice stone and emery—a granular impure variety of corundum.

¹⁶Fideicomiso de Minerales No-Metallicos Mexicanos.

¹⁷Instituto Mexicano de la Fluorita.

¹⁸Reported by Industrias Peñoles S.A. de C.V. (Peñoles) as the only major producer.

¹⁹Nitrogen content of ammonia produced by PEMEX plus liquid nitrogen.

²⁰Includes only output used to manufacture fertilizers.

²¹Series reflects output reported by Peñoles, Mexico's principal producer, plus an additional estimated 30,000 tons by a smaller operator.

²²Excluding that for cement production.

²³Includes coke made from imported metallurgical coal.

²⁴Memoria de Labores 1987, Petróleos Mexicanos.

²⁵Specified by PEMEX as "virgin stock 28" and was processed at its refineries primarily for export. Exports of virgin stock 28 were suspended during 1986 and replaced by refinery products with greater value added.

²⁶Revised to zero.

TRADE

Exports of petroleum and petroleum products were by far the most significant factor in Mexico's foreign trade, totaling \$8.5 billion or 41% of total exports in 1987. When exports of nonfuel minerals of \$1.2 billion were included, total mineral-based exports were \$9.7 billion or 47% of total exports. Crude oil was the largest single contributor to the increased value of exports, due both to increased volume and higher prices. Increased prices for several metals and increased volume of exports of silver and sulfur, more than offset decreases in exports of lead, fluorspar, and other commodities.

Significant trade agreements reached in 1987 related primarily to trade in steel products. A bilateral trade and investment agreement between Mexico and the United States, which supplements the General Agreement on Tariffs and Trade (GATT), was signed in November 1987. A further agreement was signed in December under which Mexico agreed to reduce tariffs and eliminate reference prices for steel imports while the United States agreed to an up-

ward adjustment in the Mexican steel quota.

Mexico continued to be self-sufficient with respect to many mineral products, although virtually all of its potash and much of its aluminum, iron and steel scrap, finished steel products, and phosphates were imported.

Mexico was one of the United States principal trading partners, particularly with respect to minerals and crude petroleum. In addition to crude oil, Mexico is a major supplier to the United States of celestite, cement, fluorspar, ferroalloys, natural graphite, silver, sodium sulfate, steel, sulfur, and zinc. The United States is a major supplier to Mexico of alumina and aluminum products, fertilizer materials including phosphate rock and potash, scrap iron, specialty clays, sodium carbonate, steel, sulfur, and talc. Mexico's secondary lead smelters also process significant quantities of scrap material that for environmental reasons can no longer be processed in the United States.

Table 2.—Mexico: Exports of mineral commodities¹

(Metric tons unless otherwise specified)

Commodity	1987	1986	Destinations, 1986	
			United States	Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	17	283	(2)	Belgium-Luxembourg 193, Guatemala 7, Peru 2
Metal including alloys:				
Scrap	4,898	5,291	3,272	Belgium-Luxembourg 19
Unwrought	233	2,672	2,672	
Seminufactures	2,301	1,125	806	NA
Antimony:				
Ore and concentrate	5,251	3,510	3,510	
Metal including alloys, all forms	184	140	71	Brazil 69
Arsenic: Oxides and acids	5,099	4,530	4,270	Brazil 60
Bismuth:				
Ore and concentrate	13			
Metal including alloys, all forms	436	673	463	Belgium-Luxembourg 96, Brazil 52
Cadmium: Metal including alloys, all forms	9128	549	447	United Kingdom 45, Brazil 27
Chromium: Oxides and hydroxides	NA	13	(3)	Peru 8, Chile 3, Guatemala 1
Copper:				
Ore and concentrate	262,343	298,709	10,029	West Germany 106,500, Spain 70,900, China 51,880
Oxides and hydroxides	20	261	256	China 3, Japan 2
Sulfate	190	851	836	Guatemala 19, Panama 2
Metal including alloys:				
Scrap	2,770	4,814	3,835	Republic of Korea 956, France 23
Unwrought	11,203	19,117	19,117	
Seminufactures	6,289	13,438	11,169	NA
Iron and steel:				
Iron ore and concentrate	505	1,281	37	Belgium-Luxembourg 1,003, Costa Rica 90
Metal:				

See footnotes at end of table

Table 2.—Mexico: Exports of mineral commodities¹ —Continued

(Metric tons unless otherwise specified)

Commodity	1985 ²	1986	Destinations, 1986	
			United States	Other (principal)
METALS —Continued				
Iron and steel —Continued				
Scrap	21,238	21,747	21,681	France 65; Canada 1
Pig iron, cast iron, related materials	87	67	49	France 12; West Germany 6
Ferrosilloys:				
Ferromanganese	49,943	7,300	6,293	Canada 417; Colombia 403
Ferrosilicomanganese	332	19	19	
Ferrosilicon	638	32	21	Colombia 11
Unspecified	136	225	1	Venezuela 175; Brazil 31; Japan 19
Steel, primary forms	12,778	153,274	72,106	NA
Semimanufactures:				
Bars, rods, angles, shapes, sections	207,858	405,017	81,564	NA
Universals, plates, sheets	120,422	363,798	146,428	NA
Hoop and strip	4,090	2,939	2,885	France 46; Guatemala 6
Rails and accessories	2	70	22	Guatemala 48
Wire	2,191	8,266	5,056	Canada 1,306; Belize 959
Tubes, pipes, fittings	204,075	154,078	114,892	NA
Castings and forgings, rough	23,935	23,223	22,745	Belgium-Luxembourg 186; West Germany 95
Unspecified	(*)			
Lead:				
Ore and concentrate	9,874	5,618	626	Belgium-Luxembourg 3,912; Spain 1,080
Oxides	23,549	25,130	11,328	Japan 8,003; Colombia 1,032
Metal including alloys:				
Scrap	2,122	1,852	1,792	Guatemala 40
Unwrought	107,003	104,003	26,636	Belgium-Luxembourg 36,256; Italy 15,842
Semimanufactures	962	421	370	Belize 41; El Salvador 40
Magnesium Metal including alloys, all forms	80	289	289	
Manganese:				
Ore and concentrate:				
Battery-grade	19,679	31,023	16,786	Colombia 3,896; Japan 3,000
Metallurgical-grade	110,206	83,877	16,717	Norway 28,910; Venezuela 23,520
Oxides		6	5	Costa Rica 1
Mercury	76-pound flasks	2,677	4,505	908
Molybdenum:				
Ore and concentrate	14,533	2,875		United Kingdom 1,280; West Germany 1,022; Netherlands 499
Metal including alloys, all forms		229	228	West Germany 1
Nickel:				
Ore and concentrate	— kilograms	15		All to Guatemala
Matte and speiss	23	3	2	West Germany 1
Ash and residue containing nickel	20			
Metal including alloys, semimanufactures	18	15	10	Guatemala 2; Denmark 1
Platinum-group metals: Metals including alloys, unwrought and partly wrought	41,378	1,447	1,447	
Silver: Metal including alloys, unwrought and partly wrought				
thousand troy ounces	59,637	55,396	46,335	Japan 6,349; West Germany 1,200
Tin:				
Ore and concentrate	9	908		All to Belgium-Luxembourg
Oxides	7			
Metal including alloys:				
Scrap		2	2	
Unwrought		171	170	Guatemala 1
Semimanufactures	97	191	190	Do.
Titanium:				
Ore and concentrate	— kilograms	110	110	
Oxides	1,060	818	33	El Salvador 402; Guatemala 304; Honduras 69
Tungsten:				
Ore and concentrate	1,093	772	772	
Metal including alloys, all forms	3	57	7	Sweden 30; West Germany 13

See footnotes at end of table.

Table 2.—Mexico: Exports of mineral commodities¹—Continued

(Metric tons unless otherwise specified)

Commodity	1985 ¹	1986	Destinations, 1986	
			United States	Other (principal)
METALS—Continued				
Vanadium: Ash and residue containing vanadium	251	1,360	1,360	
Zinc:				
Ore and concentrate	214,657	197,774	18,130	Belgium-Luxembourg 69,129; U.S.S.R. 33,220; Italy 26,110.
Oxides	17,982	20,563	18,984	United Kingdom 1,186; Uruguay 109.
Blue powder	3,051	2,650	2,318	Australia 108; Argentina 104.
Ash and residue containing zinc	443	1,446	1,230	Uruguay 216.
Metal including alloys				
Scrap	(*)			
Unwrought	78,292	73,929	47,670	Japan 9,492; Costa Rica 4,065.
Semimanufactures	7,752	12,294	169	Costa Rica 5,901; Argentina 1,699; Dominican Republic 1,597.
Other:				
Ores and concentrates		14	14	
Ashes and residues	1,532	172	42	China 100; Japan 16.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.				
Natural: Corundum, emery, pumice, etc.	246	1,457	1,455	Brazil 1; Dominican Republic 1.
Artificial: Silicon Carbide	313	1,791	667	Japan 1,050; Republic of Korea 74.
Dust and powder of precious and semiprecious stones	9	12	10	Ireland 2.
Grinding and polishing wheels and stones	288	165	158	Honduras 2; United Kingdom 2.
Asbestos, crude	49	(*)		All to West Germany.
Barite and witherite	34,675	29,792	29,792	
Boron materials:				
Crude natural borates	13	63	13	Colombia 50.
Oxides and acids	20	1		Mainly to Dominican Republic.
Cement, thousand tons	4,620	3,717	3,615	Belize 42; Venezuela 14.
Chalk		475	475	
Clays, crude:				
Bentonite	7,170	11,488	6,212	Netherlands 5,258; United Kingdom 18.
Fuller's earth		22	22	
Kaolin	2,527	2,012	1	Cuba 2,011.
Unspecified	129	56	(*)	Colombia 20; Peru 13; El Salvador 8.
Cryolite and chiolite	6	263		All to West Germany.
Diatomite and other infusorial earth	4,469	5,461	122	West Germany 1,350; Argentina 1,119; Colombia 1,113.
Feldspar	6	688	688	
Fertilizer materials: Manufactured:				
Ammonia	390,039	96,592	43,848	Spain 28,083; Belgium-Luxembourg 13,841.
Nitrogenous	38,922	81,333	24,325	Netherlands 17,260; Colombia 15,279.
Phosphatic	280	25,244	95	U.S.S.R. 15,056; Peru 6,732; Guyana 3,011.
Potassic	7,307	120	120	
Unspecified and mixed	821	528	526	Netherlands 2.
Fluorspar (total)	564,622	437,526	246,108	Netherlands 73,531; Canada 72,352.
Of which:				
Acid-grade	271,557	NA		
Other grades including ceramic	293,065	NA		
Graphite, natural	19,298	18,919	17,633	Spain 1,283; Panama 2.
Gypsum and plaster	3,899	2,269	2,040	India 86; Canada 56.
Iodine	1	16		All to West Germany.
Lime	46,868	18,578	17,998	Belize 580.
Magnesium compounds:				
Magnesite, crude		4		All to Nicaragua.
Oxides and hydroxides	28,995	44,342	13,456	West Germany 14,380; Argentina 6,543.
Meerscham, amber, jet	51	(*)	(*)	
Mica: Crude including splittings and waste	6	29	27	Panama 2.
Phosphates, crude	353	55		Mainly to Japan.
Pigments, mineral: Iron oxides and hydroxides, processed	2,640	2,741	2,395	Canada 139; Japan 108.
Precious and semiprecious stones other than diamond:				
Natural	5,441	834	699	Japan 129; Spain 2.
Synthetic	550	46	46	

See footnotes at end of table.

Table 2.—Mexico: Exports of mineral commodities¹—Continued

(Metric tons unless otherwise specified)

Commodity	1985 ^a	1986	Destinations, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Salt and brine, thousand tons	8,993	4,435	1,811	Japan 3,403; Canada 283
Sodium compounds, n.e.s.	1,044	1,807		Mainly to Cuba
Sulfate, manufactured	143,808	157,283	91,303	Brazil 43,255; Colombia 3,964
Stone, sand and gravel				
Dimension stone				
Crude and partly worked	2,427	2,164	1,568	China 341; Italy 38
Worked	12,635	14,692	13,627	Canada 599; Panama 77
Dolomite, chiefly refractory grade	1,121	1,461	1,065	El Salvador 290; Panama 100
Gravel and crushed rock	44,055	6,706	6,706	
Limestone other than dimension	117,700	104,636	104,636	
Quartz and quartzite	20	76	76	
Sand other than metal-bearing	63,364	29,960	28,878	Guatemala 48; El Salvador 43
Sand and gravel	18,225	11,947	11,315	Honduras 15; Nicaragua 13
Strontium minerals Celestite	40,207	30,698	28,121	Japan 2,577
Sulfur				
Elemental				
Crude including native and by-product, thousand tons	1,644	1,801	715	Romania 112; United Kingdom 81
Colloidal, precipitated, sublimed	20			
Unspecified	33	9		All to Guatemala
Dioxide	120	110	90	Costa Rica 20
Sulfuric acid	456	921	25	Guatemala 213; Panama 84
Talc, steatite, soapstone, pyrophyllite	18	20		El Salvador 15; Panama 5
Vermiculite	149	66	66	
Other				
Crude	183	303	227	Venezuela 80; Colombia 20
Slag and dross, not metal-bearing	55	410	256	Venezuela 154
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	193,983	77,436	74,492	Costa Rica 2,717; Guatemala 120
Carbon black	41,214	36,433	14,504	Switzerland 7,586; Cuba 3,090
Coal, All grades including briquets	168	801	582	Belize 232; Guatemala 17
Coke and semicoke	163,585	34,358	7	Philippines 24,351
Peat including briquets and litter	212	25	25	
Petroleum				
Crude, thousand 42-gallon barrels	524,943	470,450	238,333	Spain 71,790; Japan 60,290
Refinery products				
Liquefied petroleum gas, do.	6,635	11,121	5,148	NA
Gasoline, motor, do.	7,148	3,766		NA
Kerosene and jet fuel, do.	1,947	2,550	501	NA
Distillate fuel oil, do.	5,492	9,259	6,487	NA
Residual fuel oil, do.	8,983	14,553	9,741	NA
Asphalt, do.		16		NA
Unfinished crude oil, do.	16,954	930		NA

¹Revised. NA Not available.²Table prepared by H. D. Willis.³Less than 1/2 unit.⁴Boletín Informativo. Instituto Mexicano del Zinc, Plomo y Coproductos A.C.⁵Revised to zero.Table 3.—Mexico: Imports of mineral commodities¹

(Metric tons unless otherwise specified)

Commodity	1985 ²	1986	Sources, 1986	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	46,659	35,086	28,108	Guyana 6,024; unspecified 954
Oxides and hydroxides	197,657	88,121	83,476	Japan 2,836; Brazil 633
Metal including alloys:				
Scrap	54,050	18,218	19,043	France 70; Canada 57
Unwrought	45,236	16,085	11,271	Canada 4,315; Venezuela 500
Semimanufactures	28,639	18,736	15,891	NA

See footnotes at end of table.

Table 3.—Mexico: Imports of mineral commodities¹—Continued

(Metric tons unless otherwise specified)

Commodity	1987	1986	Sources, 1986	
			United States	Other (principal)
METALS—Continued				
Antimony Oxides	34	29	17	West Germany 11, Netherlands 1
Arsenic Metal including alloys, all forms	5	43	43	
Beryllium Metal including alloys, all forms kilograms	55	36	36	
Bismuth Metal including alloys, all forms	134	(9)	(9)	
Cadmium Metal including alloys, all forms	2	42	42	
Chromium Ore and concentrate	63,761	27,781	8,691	Cuba 7,895; Turkey 6,500
Oxides and hydroxides	79	63	63	
Cobalt Oxides and hydroxides	190	151	67	Belgium-Luxembourg 58, Netherlands 24
Metal including alloys, all forms	124	71	26	Belgium-Luxembourg 35, Canada 7
Columbium and tantalum Metal including alloys, all forms, tantalum kilograms	273	184	179	West Germany 3, United Kingdom 2
Copper Oxides and hydroxides	26	11	7	United Kingdom 3, Panama 1
Metal including alloys				
Scrap	24,655	7,431	7,449	Ethiopia 2
Unwrought	11,843	437	437	
Semimanufactures	10,926	2,963	1,878	NA
Unspecified	62,745	8,121	3,422	Chile 4,699
Iron and steel				
Iron ore and concentrate	2,137	208,617	161,121	Belgium-Luxembourg 54,918, Chile 51,574
Metal				
Scrap	839,890	430,502	365,979	West Germany 29,651, Japan 3,922
Pig iron, cast iron, related materials	20,879	10,482	8,014	Canada 1,125, Panama 800
Ferroalloys				
Ferrichromium	327	25	25	
Ferrumanganese	389	108	107	Switzerland 1
Ferrumolybdenum	52	43	43	
Ferronickel	339	49	49	
Ferronickelmanganese	20	31	31	
Ferronickel	1,412	379	393	Brazil 156, West Germany 21
Unspecified	4,354	2,335	1,527	NA
Steel, primary forms	411,661	NA		
Semimanufactures				
Bars, rods, angles, shapes, sections	74,870	NA		
Universals, plates, sheets	250,664	NA		
Hoop and strip	78,448	NA		
Rails and accessories	244,617	NA		
Wire	12,433	NA		
Tubes, pipes, fittings	51,586	NA		
Unspecified	(9)			
Lead				
Oxides	178	27	27	
Metal including alloys				
Scrap	503	1,056	1,056	
Unwrought	336	28	28	
Semimanufactures	116	13	13	

See footnotes at end of table.

Table 3.—Mexico: Imports of mineral commodities¹—Continued

(Metric tons unless otherwise specified)

Commodity	1985 ²	1986	Sources, 1986	
			United States	Other (principal)
METALS—Continued				
Lithium: Oxides and hydroxides	361	156	57	Hong Kong 99
Magnesium: Metal including alloys				
Scrap	75	17	3	Unspecified 14
Unwrought	1,121	965	812	Sweden 69; Norway 43
Semimanufactures	139	101	101	
Manganese:				
Ore and concentrate	146,454	112,353	23,913	Panama 87,443; Congo 993
Oxides	1,452	1,826	308	Belgium-Luxembourg 719; Brazil 382
Mercury	76-pound flasks	199	7	
Molybdenum:				
Ore and concentrate	52	—		
Metal including alloys				
Unwrought	15	19	(2)	Mainly from Austria
Unspecified	11	8	3	Netherlands 4; Japan 1
Nickel:				
Matte and speiss	3,539	1,896	1,217	Canada 591; Cuba 24
Oxides	125	64	5	Cuba 33; Canada 26
Metal including alloys, semimanufactures	1,505	2,662	537	NA
Platinum-group metals: Metals including alloys, unwrought and partly wrought				
Palladium	troy ounces	1,254	NA	
Platinum	do	4,343	NA	
Rhodium	do	64	NA	
Unspecified	do	1,010	NA	
Selenium, elemental	25	25	21	United Kingdom 4
Silver: Metal including alloys, unwrought and partly wrought	troy ounces	3,504	5,530	4,951
Tin:				Italy 386; West Germany 193
Ore and concentrate	5,500	6,311	6,229	Singapore 62; Bolivia 20
Oxides		39	39	
Metal including alloys:				
Scrap	156	185	135	
Unwrought	72	67	67	
Semimanufactures	70	12	6	West Germany 4; United Kingdom 1
Titanium:				
Ore and concentrate	52,918	47,129	5	Australia 47,124
Oxides	1,443	1,405	437	West Germany 435; Belgium-Luxembourg 245
Metal including alloys, all forms	144	42	38	West Germany 4
Tungsten:				
Ore and concentrate	72	(2)	(2)	
Metal including alloys, all forms	125	43	18	Austria 19; Netherlands 2
Zinc:				
Oxides	159	96	96	
Blue powder	699	239	126	Belgium-Luxembourg 112
Metal including alloys:				
Scrap	1,193	1,376	1,372	Ethiopia 4
Unwrought	2	2	2	
Semimanufactures	434	184	176	West Germany 6; Netherlands 2
Zirconium: Ore and concentrate	4,678	1,177	821	Australia 257; Austria 43
Other:				
Ores and concentrates	7,753	426	374	United Kingdom 19; Netherlands 18
Base metals including alloys, all forms	667	308	238	West Germany 21; Belgium-Luxembourg 12
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	763	1,061	1,002	West Germany 58; Switzerland 1
Artificial:				
Corundum	4,350	1,446	133	Brazil 582; West Germany 461; Austria 266
Silicon carbide	521	135	59	Brazil 76
Grinding and polishing wheels and stones	458	345	230	West Germany 84; Italy 11
Asbestos, Crude	54,871	28,209	7,461	Canada 14,089; Republic of South Africa 3,009
Barite and witherite	16	99	98	Switzerland 1

See footnotes at end of table.

Table 3.—Mexico: Imports of mineral commodities¹—Continued

(Metric tons unless otherwise specified)

Commodity	1985 ²	1986	Source, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS - Continued				
Boron materials: Crude natural borates	1,973	976	976	
Bromine	156	99	99	
Cement	9,592	8,438	5,303	France 2,277; Brazil 296.
Chalk	5,322	1	(²)	Mainly from Switzerland
Clays, crude:				
Bentonite	685	509	507	United Kingdom 2.
Kaolin	91,219	85,424	85,229	Spain 79; United Kingdom 59.
Unspecified	131,784	109,818	109,285	West Germany 210; France 199.
Cryolite and chiolite	86	832	(²)	Denmark 817; Belgium-Luxembourg 14.
Diamond				
Industrial stones	816	139	71	Italy 60; United Kingdom 4.
Dust and powder	1,348	548	509	Belgium-Luxembourg 18; West Germany 12.
Diatomite and other infusorial earth	142	513	502	United Kingdom 10.
Feldspar, fluor spar, related materials	1,043	4,448	4,328	Canada 112; West Germany 8.
Fertilizer materials:				
Crude, n.e.s.	1,016	791	790	Australia 1.
Manufactured:				
Ammonia	76,950	27,070	12,931	Venezuela 14,138.
Nitrogenous	117,610	184,321	3,598	Romania 148,177; U.S.S.R. 32,195.
Phosphatic	403,453	249,732	183,896	Tunisia 32,000; Israel 32,836.
Potassic	37,173	29,181	29,181	
Unspecified and mixed	116,467	1,953	1,364	Spain 316; Belgium-Luxembourg 233.
Graphite, natural	48	48	20	Brazil 16; West Germany 7.
Gypsum and plaster	11,400	8,546	8,527	West Germany 15; Spain 4.
Iodine	322	141	131	Japan 7; West Germany 2.
Lime	896	729	729	
Magnesium compounds:				
Magnesite, crude	9	1,573	1,562	France 7; Belgium-Luxembourg 4.
Oxides and hydroxides	920	1,701	1,661	Italy 20; West Germany 8.
Mica				
Crude including splittings and waste	132	153	126	West Germany 18; United Kingdom 5.
Worked including agglomerated splittings	92	94	89	Belgium-Luxembourg 3; Sweden 1.
Phosphates, crude	1,038	1,097	295	Morocco 772; Jordan 30.
Pigments, mineral: Iron oxides and hydroxides, processed	448	588	568	West Germany 16; United Kingdom 3.
Potassium salts, crude	239,849	144,588	31,748	Canada 49,209; U.S.S.R. 42,626.
Precious and semiprecious stones other than diamond				
Natural	805	40,215	NA	NA
Synthetic	1,803	41,874	710	France 31,986; Switzerland 5,600; Thailand 3,510.
Pyrite, unroasted	151	124	20	West Germany 104.
Quartz crystal, piezoelectric				
kilograms	23,583	36	36	
Salt and brine	584	680	595	West Germany 65.
Sodium compounds, n.e.s.				
Carbonate, manufactured	94,632	78,191	78,191	
Sulfate, manufactured	40	50	15	Netherlands 35.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	3,582	1,667	546	Italy 489; Cuba 364.
Worked	11,973	9,781	9,528	Guatemala 96; Dominica 88.
Calcite, common	1,666	1,506	1,449	Italy 36; United Kingdom 19.
Dolomite, chiefly refractory-grade	38	1,497	1,497	
Gravel and crushed rock	7,101	2,799	2,770	Italy 20; United Kingdom 9.
Quartz and quartzite	773	405	285	Sweden 83; West Germany 20.
Sand other than metal-bearing	112,319	68,305	68,156	United Arab Emirates 88; Sweden 30.
Sulfur:				
Elemental:				
Crude including native and byproduct	56,883	239,342	115,786	Canada 123,421; Belgium-Luxembourg 135.
Colloidal, precipitated, sublimed	149	35	30	West Germany 5.
Sulfuric acid	38,775	22,383	22,383	
Talc, steatite, soapstone, pyrophyllite	149,220	79,279	77,749	Italy 840; France 240.

See footnotes at end of table.

Table 3.—Mexico: Imports of mineral commodities¹—Continued

(Metric tons unless otherwise specified)

Commodity	1985 ^F	1986	Sources, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS —Continued				
Vermiculite	658	462	457	China 5
Other: Crude	12,076	9,051	8,623	Australia 237, Spain 68
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	1,908	1,048	1,047	West Germany 1
Carbon black	209	NA		
Coal:				
Briquets of anthracite and bituminous coal, thousand tons	1,064	240	129	Colombia 55, Canada 53
Lignite including briquets	6,743	3,592	3,592	
All grades including briquets	(³)			
Coke and semicoke	151,342	61,396	25,221	Panama 39,076, Canada 99
Gas, natural, million cubic feet	2,081	1,789	1,789	
Peat including briquets and litter	256	268	268	
Petroleum refinery products:				
Liquefied petroleum gas				
thousand 42-gallon barrels	13,524	8,987	7,895	NA
Gasoline, motor, do.	23	14	5	NA
Mineral jelly and wax, do.	277	236	134	Brazil 79, Spain 12
Kerosene and jet fuel, do.	439	504	290	NA
Lubricants, do.	1,099	1,274	1,053	NA
Residual fuel oil, do.	4,254	11,096	7,148	NA
Petroleum coke, do.	883	880	826	Australia 54

¹Revised. NA Not available.²Table prepared by H. D. Willis.³Less than 1/2 unit.⁴Revised to zero.

COMMODITY REVIEW

METALS

Bismuth.—Production of refined bismuth increased for the fourth year and reached a total of 561 tons, which was the highest production since 1980. Exports were 489 tons, domestic consumption was 39 tons, and the balance of 33 tons apparently went into inventory, continuing a trend that has persisted since 1983. Most of the exports went to the North American market, for which Mexico is the largest supplier.

Cadmium.—Mine production of cadmium increased for the fourth year, and production of refined cadmium reached a new record high. Domestic cadmium consumption declined for the fifth year in a row to 174 tons but exports increased to 940 tons, and the total of domestic and foreign sales reached a new record high of 1,114 tons.

Copper.—There was notable change in 1987 for the Mexican copper industry. The two major producers, Cia. Minera de Cananea with its mine and smelter at Cananea and Mexicana de Cobre with its La Caridad mine and smelter near Nacozari, both in the State of Sonora, completed major expansion programs during the year. The Government, through Nacional Financiera S.A. (NAFINSA), assumed control of Mexicana de Cobre in order to avert a declaration of bankruptcy. Cananea was owned almost entirely by Government agencies. At year-end, the Government announced a plan to fully privatize Mexicana de Cobre. Also during the year, an agreement between Mexico and the United States limiting sulfur dioxide emissions from copper smelters on each side of the border was signed under the basic 1983 Border Environment Agreement.

The principal developments at La Caridad were the completion of the 230,000-ton-per-year smelter and the start of construction of a 500,000-ton-per-year sulfuric acid plant. Upon completion the plant should recover about 98% of the sulfur dioxide created in the copper smelting process. Worldwide marketing of the acid will be handled by a subsidiary of the Boliden Co. Reported copper production at La Caridad in 1987 was 131,208 tons, which included 80,811 tons of copper in concentrates and 52,418 tons in anodes.

At Cananea expansion of concentrator capacity to 95,000 tons per day was completed, and construction of a second solvent extraction-electrowinning (SXEW) plant to produce an additional 60 tons per day of cathodes was started. Completion of the concentrator expansion will enable the Cananea smelter to operate at its full capacity of 45,000 tons per year of blister copper. Retrofitting of emission controls at the Cananea smelter would be required only if the capacity of the smelter were to be increased. Concentrates that cannot be smelted at Cananea will either be smelted at La Caridad or exported. Cananea was reported to have acquired the copper smelter of Cia. Minera de Santa Rosalia S.A. at Santa Rosalia, Baja California, which would add 15,000 tons per year of smelting capacity when the smelter is refurbished. Reported production at Cananea included 37,068 tons of copper in concentrates, 43,922 tons of copper in blister copper, and 9,662 tons of copper in copper cathodes. Production included 1,570 tons of copper contained in purchased concentrates, resulting in net production from Cananea of 89,121 tons after consideration of the metallurgical loss in smelting of purchased concentrates.

Mexicana de Cobre operated Mexico's only copper refinery and produced 120,377 tons of refined copper in 1987. Proposals to expand the capacity of the existing plant and/or to build a new refinery in the northwestern region of Mexico, close to Cananea and La Caridad, were under study but no action was taken.

Domestic sales of refined copper were reported by different sources to be from 124,000 tons to 129,000 tons. Imports of refined copper were estimated to be approximately 30,000 tons for a total consumption of approximately 155,000 tons. Most of the concentrate production that was not smelted locally was exported.

Gold.—The Guanajuato district in the State of Guanajuato is the most important gold-producing area in Mexico, accounting for about one-fourth of reported Mexican gold production. The Torres Mining Complex—Industries Peñoles S.A. de C.V. (Peñoles), Cia. Minera Fresnillo S.A. de C.V., Lacana Mining Corp. of Toronto, Can-

ada, and an agency of the Mexican Government have ownership interests—was the largest producer in the Guanajuato district with reported production of 42,959 troy ounces from six mines during the first 9 months of 1987. Other important gold producers in Mexico were Corporación Industrial Sanluis S.A. de C.V. from mines in the San Dimas district in the States of Durango and Sinaloa; Cia. Real del Monte y Pachuca S.A. from mines in the Pachuca area in the State of Hidalgo; and Cia. Minera de Cananea S.A. and Mexicana de Cobre as a by-product from their porphyry-type copper mines in the State of Sonora.

Minera Zapata S. de R.L. de C.V., an affiliate of Phelps Dodge Corp. of Phoenix, Arizona, announced the discovery of significant gold mineralization in the northern portion of the State of Sonora and reported that studies to determine the economic viability of developing a gold mining operation had begun.

Iron Ore.—Mexican iron ore production increased slightly in 1987 to 7.5 million tons of pellets. Principal sources of crude ore were the Ferrotepec Mine in the Las Truchas district of Michoacán, the Peña Colorada Mine in Colima, the La Perla Mine in Chihuahua, and the Hércules Mine in Coahuila. Concentrators are operated at the mine sites. Pellet plants are operated in Colima by the Peña Colorada consortium and at steel plants at Lázaro Cárdenas, Michoacán (SICARTSA), and Monclova, Coahuila (AHMSA). In addition, 45,000 tons of iron ore pellets, 101,000 tons of lump ore, and 344,000 tons of sinter fines were imported.

Iron and Steel.—Production of crude steel in Mexico increased by 5% more than that of 1986 to 7.6 million tons, second only to the record high 7.7 million tons produced in 1981. Finished steel products (rolled products plus castings and forgings) produced totaled 5.8 million tons for a productivity (ratio of finished products to crude steel) of 77%, compared with the 5.6 million tons of finished products and productivity of 79% achieved in 1986.

Distribution of production by company and by product lines is shown in tables 4 and 5.

Table 4.—Mexico: Production of crude steel, by group and company

(Thousand metric tons)

Group and company	1985	1986	1987
Siderúrgica Mexicana (SIDERMEX) Group			
Altos Hornos de México S.A. (AHMSA)	2,603	2,868	3,085
Fundidora de Monterrey S.A. (FMSA) ¹	943	255	
Siderúrgica Lázaro Cárdenas-Las Truchas S.A. (SICARTSA)	613	1,192	1,190
Total	4,159	4,315	4,275
Private companies			
Tubos de Acero de México S.A. (TAMSA)	279	233	466
Hylsa de México S.A. (HYLSA)	1,671	1,582	1,662
Others	1,258	1,045	1,168
Total	3,208	2,860	3,296
Grand total	7,367	7,175	7,571

¹Permanently closed in 1986 after incomplete operating year

Table 5.—Mexico: Production of finished steel, by type

(Thousand metric tons)

Type	1985	1986	1987
Castings and forgings	56	26	40
Rolled products:			
Flat-rolled	2,797	2,229	2,355
Nonflat products	2,953	3,116	3,148
Seamless tubes	292	208	288
Total	6,042	5,623	5,791

During 1987, 1.2 million tons of finished steel was exported and 331,000 tons was imported, compared with exports of 1.1 million tons and imports of 451,000 tons in 1986. Apparent domestic consumption of finished steel products was 4.9 million tons in 1987 compared with 5.0 million tons in 1986. The increased production, exports, and decreased apparent consumption can be attributed to the progressive rationalization and improvements in efficiency of the Mexican steel industry and also to the increased participation by Mexico in the U.S. market for imported steel and the continued economic restrictions on the domestic Mexican economy.

Principal developments in the Mexican iron and steel industry during the year were the continuation of the phase-2 expansion of the SICARTSA works at Lázaro Cárdenas, Michoacán; the implementation of plans to improve production efficiency at the iron ore and coal mines of the Sidermex Group in Chihuahua and Coahuila; and the submission of requests to the World Bank for the financing of an integrated program of modernization and quality improvement.

Production and export of ferroalloys continued to increase. The production of ferro-manganese, silicomanganese, and ferro-

molybdenum, as well as the production of ferroalloys as a group, reached record-high levels. The most significant production increases over 1986 were of silicomanganese and ferrochromium. Cia. Minera Autlán continued to be the principal producing company.

Lead.—Indicated mine production of lead did not change significantly from that of 1986, nor did the production of primary and secondary refined lead. Reported domestic consumption of primary refined lead increased over that of 1986 by about 5,400 tons or 6.4% while exports decreased below that of 1986 by about 16,300 tons to 88,352 tons. The difference in indicated domestic consumption was largely in inventory accumulation and in increased use of tetraethyl lead in gasoline. This latter usage suggests that production of leaded gasoline for export was also a major end user of Mexican lead.

Manganese.—Production of metallurgical manganese ore in Mexico declined sharply from levels achieved in 1986, reflecting the depressed state of the world steel industry and resultant inventory surplus of manganese ore and ferroalloys. Minera Autlán continued to be the major producer, producing 581,300 tons of crude manganese carbonate ore and 336,000 tons of calcined

product from its mine and plant at Molango, Hidalgo. Production of battery-grade ore rose by 7% from 38,700 tons to 41,300 tons, reflecting the increased usage of dry cells in radios and similar consumer products. At yearend, demand for both calcined manganese ore for metallurgical use and battery-grade ore was picking up. Prices for manganese ore declined by about 5% during the year, whereas prices for ferroalloys generally rose, although not at the same rate as the general inflation.

Domestic sales of calcined manganese ore (nodules) declined slightly in 1987, whereas export sales rose. For the first year some sales of crude (uncalcined) manganese carbonate were made, leading to an overall increase in ore sales in 1987. Exports of standard- and medium-carbon ferromanganese declined while exports of silicomanganese increased, leaving total exports of manganiferous alloys virtually unchanged.

Late in the year, Minera Autlán announced plans to begin production of electrolytic manganese dioxide at a new plant in Tamos, Veracruz. Capacity of the plant was to be about 12,000 tons per year. The plant would be operated in conjunction with Minera Autlán's manganese sulfate plant at the same location.

Molybdenum.—Reported molybdenum production increased by approximately 31% over that of 1986. Principal producers continued to be Mexicana de Cobre, which recovers molybdenite as a byproduct from the La Caridad copper mine in Sonora, and Minera Cumobabi S.A. de C.V., a subsidiary of Empresas Frisco S.A. de C.V., which produces molybdenite as a primary product from its mine in Sonora. Recovery of molybdenite at La Caridad increased as a result of increased ore production, while production at Cumobabi declined as mine operations were adjusted to improve operating results.

Silver.—Mexico was the leading producer of mined silver in the world, and silver was the most important mineral produced in Mexico, aside from petroleum. Silver was produced from many mines, both large and small, and was generally a coproduct or principal product of those mines. The largest single mine was Real de Ángeles at Noria de Ángeles, Zacatecas, which produced 11.2 million troy ounces in 1987. Major producing companies included Peñoles and affiliates; Grupo Industrial Minera Mexico S.A. de C.V. (Grupo IMM-SA); Minerales de Bolaños S.A.; Minera Real de Ángeles S.A. de C.V.; Empresas Frisco; Industrial Sanluis; and Real del Monte y Pachuca. Virtually all the silver

produced in Mexico, with the exception of that contained in exported copper concentrates and blister copper, is refined by Met-Mex Peñoles de C.V., a subsidiary of Peñoles, at its Torreón, Coahuila, metallurgical complex or by Industria Minera México S.A. (IMMSA) at its Monterrey, Nuevo León, complex.

Mine production of silver was not significantly different from that of 1986, with production decreases being registered at Real de Ángeles and IMMSA and increases being recorded by Peñoles and affiliates and Empresas Frisco. Indicated production of refined silver increased by 8% over that of 1986, suggesting that significant quantities of silver in inventory were moved to market during the year. Sales data indicated that 75% of the refined silver sold in 1987 was destined for export markets.

The San Antonio Mine of Industrial Sanluis was the only significant new mine opening reported in 1987. The mine is in the State of Sinaloa and was reported to have the capacity to produce 90,500 tons of concentrate containing 22,000 ounces of gold and 850,000 ounces of silver per year.

Zinc.—Mine production of zinc was essentially unchanged from that of 1986 while production of refined zinc increased 6% to approximately 186,000 tons. Reported domestic sales increased from about 85,000 tons to nearly 102,000 tons, while exports increased marginally over 1986 to nearly 89,000 tons. Total reported sales were almost 191,000 tons, indicating a significant reduction in refined metal inventory.

INDUSTRIAL MINERALS

Barite.—Production of barite in 1987 rebounded to more than 401,000 tons, 25% more than in 1986 but still significantly lower than the almost 468,000 tons produced in 1985. The largest producer was Barita de Sonora S.A. de C.V., a state-owned company with a capacity of about 100,000 tons per year. Peñoles also produced barite as a coproduct from its La Minita Mine in Michoacán. During 1987, barite production from La Minita increased to 79,316 tons from 58,030 tons produced in 1986.

Cement.—Production of cement in Mexico continued the trend of the past several years and increased to a record 22.7 million tons, approximately 70% of installed capacity of 32.9 million tons. This compares with production of 19.8 million tons and an operating rate of about 60% in 1986. The acquisition of Grupo Cemento Anahuac by Cementos Mexicanos S.A. raised the latter company's annual capacity to 15.2 million tons; the combined companies produced 11.7

million tons in 1987. The next largest producer was Cementos Tolteca, with annual capacity of 7.1 million tons.

During 1987 Mexico exported 4.5 million tons of clinker and cement, of which Cementos Mexicanos S.A. contributed 2.8 million tons. Cement from Mexico is now distributed throughout the Southwest and Gulf States as well as the Atlantic seaboard.

Fluor-spar.—Reported fluor-spar production declined modestly in 1987, although Mexico continued to be among the world's leading producers. Sales, as reported by the Instituto Mexicano de la Fluorita A.C., increased from 724,000 to 756,000 tons and exceeded reported production by about 32,000 tons, suggesting that there were significant inventory adjustments during the year. Reported export sales declined modestly to 441,000 tons, of which 282,000 tons was exports to the United States. Reported domestic sales increased to 315,000 tons.

Magnesium Compounds.—Mexico's production of magnesia rose more than 18% from the low level of 1986. Magnesia and sodium sulfate are produced from brines by Quimica del Rey S.A. at Laguna del Rey, Coahuila, while magnesia is produced from seawater by Quimica del Mar S.A. at Ciudad Madero, Tamaulipas. Both companies are subsidiaries of Peñoles. Reported exports of magnesium oxide increased to about 16,000 tons.

Phosphate Rock.—Principal producers of phosphate rock continued to be Rosas Fosfórica Mexicana S.A. de C.V. (ROFO-MEX), with its mine and plant at San Juan de la Costa in Baja California Sur, and Minerales Industriales S.A. de C.V., with its mine in the Municipio de Pacula, Hidalgo. ROFOMEX produced 467,942 tons of phosphate concentrates with an average grade of 30.28% P_2O_5 and shipped 457,415 tons, equal to about 21% of apparent national consumption.

During 1987, ROFOMEX continued its modernization and development program. Emphasis was placed on development of an underground mine to replace production from the open-cut mine when depleted. The underground mine will use both continuous miners and conventional room and pillar mining. The company stopped work in the Santo Domingo deposit, also in Baja California Sur; took steps to improve mill recovery; built several new houses to reduce employee turnover; developed a new financing plan; and took other steps to reduce losses and improve its return on investment.

Apparent domestic consumption of phos-

phate rock was 2.2 million tons, of which about 29% was produced locally. Principal sources of imported phosphate rock were Morocco and the United States.

Salt.—Mexico was one of the major salt-producing nations in the world with reported production of 6.4 million tons. The principal producer was Exportadora de Sal S.A. de C.V. (ESSA), which has the capacity to produce 5 million tons per year by solar evaporation at Guerrero Negro, Baja California. Domestic consumption is about 1 million tons per year with the balance exported, mainly to Japan and the United States.

Strontium Minerals.—Mexico's production of celestite (strontium sulfate) continued to grow, reaching a record-high level of almost 48,000 tons. Major producers are Cía. Minera La Valenciana S.A. (CMV) from its mine near Torreón, Coahuila, and Sales y Oxidos S.A. from mines near Monterrey, Nuevo León. CMV and Sales y Oxidos each convert part of their production to strontium carbonate in plants at Torreón and Monterrey, respectively. During 1987, 27,500 tons of celestite was exported to the United States and 2,000 tons was exported to Japan. The balance of Mexican celestite was converted to strontium carbonate in Mexico. Most of the strontium carbonate product was also exported to the Far East and the United States.

Sulfur.—Mexico produced sulfur from Frasch mines at the Isthmus of Tehuantepec, as byproduct sulfur recovered from sour crude oil and natural gas, and as sulfuric acid produced as a byproduct from metallurgical operations. Frasch mines were operated by state-owned Azufrera PanamERICANA S.A. at Coahuila and Jáltipan, and by Cía. Exploradora del Istmo S.A., owned 66% by the State and 34% by Texasgulf Inc., at Texistepec, all in the State of Veracruz. Principal sources of byproduct sulfuric acid include the smelting complex of Peñoles at Torreón, Coahuila, which produced 334,669 tons in 1987; the San Luis Potosí smelter of IMMSA and the Mexicana de Cobre smelter at La Caridad. When the La Caridad acid plant is operating at full capacity, the total byproduct sulfuric acid capacity in Mexico will be well over 1 million tons annually.

Apparent domestic consumption of sulfur was about 1 million tons, or about 50% of total production. Reported exports were 910,034 tons. Mexicana de Acido, a subsidiary of Mexicana de Cobre, was building

a maritime terminal in Guaymas, Sonora, to facilitate shipment of sulfuric acid from the La Caridad smelter.

MINERAL FUELS

Coal.—The only significant mining of coal in Mexico took place in the Pecos-Rio Escondido and Salinas Basins in the State of Coahuila. The Pecos-Rio Escondido Basin is close to the site of Piedras Negras on the Rio Grande. Steam coal from this basin was mined by Minera Carbonifera Rio Escondido S.A. (MIRE) from three underground and two open-pit seams and was used exclusively for power generation at the nearby 1,200-megawatt Rio Escondido thermal power station. Steam coal production in 1987 was 4.1 million tons.

The Salinas Basin is situated between Piedras Negras and the city of Matamoros. The principal mines in this basin are operated by the mining units of the Government-owned steel companies grouped under Siderurgica Mexicana (SIDERMEX), which produced 5.7 million tons of metallurgical coal; Grupo IMMSA, which produced 535,495 tons; and the Comision de Fomento Minero, which produced 877,694 tons. Total run-of-mine production was 7.0 million tons. Virtually all of the coal produced from the Salinas Basin was shipped to washing plants, from which metallurgical coal was recovered. Raw coal washed was 6.3 million tons, from which 3.0 million tons of washed coal was recovered. Reported shipments of clean coal were 3.0 million tons, of which 2.2 million tons went to coke plants in the Coahuila area, 7,833 tons went to the Comision Federal de Electricidad for power generation, and the balance of 742,893 tons presumably went to the SICARTSA steel plant in Lazaro Cardenas, Michoacan. Reported coke production was 2.3 million tons, whereas total shipments were reported to be 2.4 million tons, indicating an inventory drawdown of about 100,000 tons. Shipments to steel plants were 2.1 million tons, or 85% of total shipments.

Coke production declined for the fifth year in a row, and was 25% below the record-high level of 3.1 million tons produced in 1981. During the same period, production of pig iron remained relatively constant, reaching a high of 3.9 million tons in 1984 versus a prior low of 3.5 million tons in 1983. The overall pattern of declining coke production versus stable pig iron production suggests that the Mexican steel industry has achieved a substantial reduc-

tion in the coke rate (tons consumed per unit of iron produced) in the past several years.

Petroleum and Natural Gas.—During 1987, Mexico produced 2,624 million barrels of crude oil, condensate, and natural gas liquids and 3,431.1 million cubic feet of natural gas per day, ranking 5th and 13th in the world, and representing increases over 1986 production of approximately 4.5% and 2.0%, respectively. Throughput at refineries and petrochemical plants was 1,334 million barrels per day and crude oil exports were 1,334 million barrels per day. All of Mexico's natural gas production was used within the country.

Exploration, production, refining, and sale of petroleum and natural gas in Mexico is a state monopoly and is carried out by the national petroleum company, Petróleos Mexicanos (PEMEX). Export sales of crude oil and refined products were \$8.48 billion as compared with imports of refined products of \$446 million, leaving a net positive contribution to the national trade accounts of \$8.03 billion. PEMEX was Mexico's largest industry, contributing about 10% of the gross domestic product and 40% of national revenue.

Mexico's hydrocarbon production was from fields bordering or in the Gulf of Mexico, which were grouped for reporting purposes into five zones. The most important of these was the Marine Zone, which encompasses a group of offshore fields in the Bay of Campeche and produced about 46% of Mexico's crude oil and 28% of Mexico's natural gas. The Southeastern Zone, comprised of several fields in the States of Chiapas, Tabasco, and the southeastern portion of the State of Veracruz was the next most important, producing about 26% and 55% of Mexico's crude oil and natural gas, respectively. The Southern Zone, lying to the west and southwest of the City of Veracruz, and the Central Zone, centered on Poza Rica in northern Veracruz and including the offshore wells of the famous "Golden Lane" were about equal in importance, with each producing about 3% and 3.7% of Mexico's crude oil and natural gas, respectively. The Northern Zone, encompassing the coastal regions north of Tampico and extending northwesterly from Matamoros along the Rio Grande valley was more important for natural gas than for oil, producing about 10% of Mexico's natural gas but less than 2% of Mexico's crude oil.

Table 6.—Mexico: Petroleum and natural gas production

Zone and district	Natural gas (million cubic feet)			Crude oil ¹ (thousand 42-gal ² on barrels)		
	1985	1986	1987	1985	1986	1987
Marine Zone: Bay of Campeche	348,397	316,711	353,880	321,646	367,385	615,477
Southeastern Zone:						
Villahermosa ³	665,344	643,532	642,963	299,963	241,449	238,247
Comalcalco District	7,144	8,395	5,789	6,287	6,120	5,961
Ciudad Pemex	79,639	71,696	59,624	4	16	23
Total ³	752,118	729,613	708,376	367,168	247,579	243,231
Southern Zone:						
Agua Dulce District	14,157	15,930	24,396	14,325	14,479	14,827
El Plan District	15,079	17,812	19,989	19,473	10,139	10,414
Nanchital District	1,162	1,022	868	1,433	1,331	1,398
Total ³	30,398	34,764	45,163	35,230	25,949	26,541
Central Zone:						
Poza Rica	30,977	26,755	24,940	27,193	26,480	23,960
Papaloapan Basin	22,181	20,895	20,645	2,487	2,463	2,360
Nueva Faja de Oro	2,606	1,350				
Total ³	55,764	48,910	45,485	29,680	28,944	26,320
Northern Zone:						
Northern District	13,056	16,534	16,971	8,444	9,312	9,688
Southern District	7,162	6,862	8,037	6,687	6,880	6,631
Northern Frontier District	106,452	194,938	99,314	99	92	79
Total ³	126,670	128,334	124,322	15,230	16,285	16,401
Grand total ³	1,315,387	1,252,352	1,276,938	803,114	686,092	921,330

¹ Does not include condensate.² Referred to as Mesozoic.³ Data may not add to totals shown because of independent rounding.

Source: Petróleos Mexicanos, Memoria de Labores, 1985, 1986, and 1987.

PEMEX operates 9 refineries, plus an additional 11 petrochemical and natural gas treatment plants, and the country was essentially self-sufficient with respect to petroleum-based products. Some specialty

lubricants and petrochemical feedstocks are imported, along with very small quantities of natural gas, but these imports were more than offset by exports of other refinery and feedstock products.

Table 7.—Mexico: Salient crude oil statistics

		1983	1984	1985	1986	1987
Exports:						
Quantity	thousand 42-gallon barrels	561,005	556,479	524,943	470,704	480,261
Value	millions	\$14,821	\$14,968	\$13,296	\$15,582	\$7,561
Share of total Mexican exports	percent	69	62	61	25	4
To the United States:						
Total	thousand 42-gallon barrels	279,703	252,454	299,031	235,176	214,661
Share of total U.S. imports	percent	23	19	19	16	11

¹ Revised.

Exploration activity in 1987 was considerably reduced, with a total of 103 wells completed during the year, compared with 246 wells completed during 1986. Of the wells drilled in 1987, 27 were exploration or wildcat wells while the remaining 76 were development wells. Six of the exploration wells resulted in oil or oil and gas discoveries, with the most important being the Iríde 140 and Gaucho 1 wells in the

Villahermosa, Tabasco area, yielding 2,447 and 1,050 barrels of oil per day, respectively, and the Huatempo 1 well in the North eastern Frontier area, which yielded 3.1 million cubic feet of gas per day. Of the 103 wells drilled, 66 were completed as producers, with 33 of these wells being in the Bay of Campeche. One offshore well, the Yun-1 in the Bay of Campeche blew-out and caught fire in October 1987, but the oil spill

was contained and the fire extinguished without notable environmental damage. A total of 121 wells were either completed or drilling at yearend for a total length of 466,814 meters or 3,858 meters per well. Although the average depth per well decreased slightly in 1987, the average depth of exploration wells increased dramatically from 4,464 to 5,362 meters.

Crude oil reserves at yearend were 47.176 billion barrels of oil and 6.934 billion bar-

rels of condensate. Although condensate reserves rose slightly, total liquid hydrocarbon reserves declined for the fourth year in a row. During the 1983-87 period, PEMEX produced a total of 6.5 billion barrels of oil and oil equivalents and found a total of 3.5 billion, for a net decrease of 3.0 billion barrels. Total hydrocarbon reserves at yearend were 69 billion barrels of oil equivalent.

¹Economic geologist, Division of International Minerals.

Table 8.—Mexico: Proven hydrocarbon reserves

(Million 42-gallon barrel; —less otherwise specified)

Zone	Dry natural gas (billion cubic feet)	Liquid hydrocarbons			
		Crude oil	Condensate	Dry natural gas liquid equivalent	1987 Total
1986 total	75,796	46,941	6,829	15,120	XX
1987					
Marine (Bay of Campeche)	12,903	36,772	3,086	2,391	32,249
Chicontepec	26,692	10,905	1,329	5,339	17,564
Southeastern	23,219	7,173	1,843	4,624	13,740
Southern	1,130	793	69	226	1,090
Central	3,456	1,094	250	644	1,988
Northern	430	419	30	90	539
Northeastern Frontier	7,887	18	236	1,576	1,830
Total	74,891	47,176	6,934	14,890	69,000

XX Not applicable

Source: Petróleos Mexicanos, Memoria de Labores, 1986 and 1987